Claims

1. Method for chemically treating a liquid medium loaded with nitrates, characterized in that it comprises at least one step of contacting zinc with said liquid medium, whose pH is less than 4.

2. Method according to Claim 1, characterized in that the pH of said liquid medium is maintained by a regular adjustment, which consists in adding an appropriate quantity of acid to the liquid medium.

3. Method according to Claim 2, characterized in that the acid is hydrochloric acid.

4. Method according to any one of Claims 2 and 3 characterized in that the pH adjustment is carried out at least every half hour for the duration of the treatment.

5. Method according to any one of the preceding claims, characterized in that the temperature of the liquid medium during the contacting step is greater than 20°C.

6. Method according to any one of Claims 1-4, characterized in that the temperature of the liquid medium is approximately 20°C.

7. Method according to any one of the preceding claims, characterized in that the zinc is in the form of a powder.

8. Method according to Claim 7, characterized in that the ratio by weight between the zinc and the nitrates in solution is at least 5.

9. Method according to any one of Claims 7 or 8, characterized in that the liquid medium is subjected to stirring.

10. Method according to Claim 9, characterized in that the stirring is carried out by pulses or by static mixers.

11. Method according to Claim 9, characterized in that the liquid medium is subjected to stirring of at least 0.55 m/s.

12. Method according to any one of the preceding claims, characterized in that the initial concentration of nitrates in the liquid medium is greater than 25 mg/L.

13. Method according to any one of the preceding claims, characterized in that the initial concentration of nitrates in the liquid medium is greater than 50 mg/L.

14. Method according to any one of Claims 1-6, characterized in that the zinc is in the form of chips.

15. Method according to Claim 14, characterized in that the zinc chips are degreased and rinsed with distilled water.

16. Method according to any one of Claims 14 or 15, characterized in that the contact surface area between the zinc and the liquid medium is at least 0.0156 m^2/L.

17. Method according to Claim 16, characterized in that the contact surface area between the zinc and the liquid medium is approximately 0.25 m^2/L.

18. Method according to any one of the preceding claims, characterized in that the liquid medium consists of drainage waters.

19. Method according to Claim 18, characterized in that the concentration of nitrates in the drainage waters is greater than 1 g/L.

20. Method according to any one of the preceding claims, characterized in that the flow rate of circulation of the liquid medium in contact with the zinc is greater than 0.005 m/s.

21. Method according to Claim 20, characterized in that the flow rate of circulation of the liquid medium in contact with the zinc is approximately 0.01 m/s.

22. Method according to any one of the preceding claims, characterized in that it comprises, in addition, a step of electrolysis of the liquid medium.

23. Method according to Claim 22, characterized in that the electrolysis step consists in causing the liquid medium (68) to circulate in at least one electrolysis cell (110a, 110b, 110c, 110d, 110e, 110f) in which a current circulates between two electrodes, an anodic electrode (109a, 109b, 109c, 109d) and a cathodic electrode (108a, 108b, 108c), respectively.

24. Method according to Claim 23, characterized in that each cathodic electrode (108a, 108b, 108c) is produced by the compression of carbon particles between two perforated plates (116b, 116b') into which at least one electrode forming means (117) is inserted while being connected to the negative pole of a generator.

25. Method according to any one of Claims 23 or 24, characterized in that the anodic electrode (109a, 109b, 109c, 109d) is produced by the compression of zinc chips between two perforated plates (118a, 118a', 118b, 118b') into which at least one electrode forming means (119b, 119c) is inserted while being connected to the positive pole of a generator.

26. Method according to any one of Claims 23-25, characterized in that the liquid medium (68) circulates in at least six electrolysis cells (110a, 110b, 110c, 110d, 110e, 110f).

27. Method according to any one of Claims 22-26, characterized in that the pH of the liquid medium is maintained above 5 and preferably equal to 10 for the entire duration of the electrolysis step.

28. Method according to any one of Claims 23-27, characterized in that the potential applied between the anodic electrode (109a, 109b, 109c) and cathodic electrode (108a, 108b, 108c) is approximately 2 volts for a current intensity between 1.5 and 1.8 amperes per L of solution treated.

29. Device for chemically treating a liquid medium loaded with nitrates, characterized in that it comprises at least one liquid nitrate reduction enclosure (56), which comprises a liquid inlet (57), at least one zinc layer (70, 85, 85b, 85c, 99a, 99b, 99c, 99d, 99e, 99f, 99g), a means for the circulation of said liquid medium, (59), through said zinc layer, and a liquid medium outlet (58) of the enclosure (56), and in that the pH of the liquid medium is less than 4.

30. Device according to Claim 29, characterized in that it comprises at least one pH regulator (93a, 93b, 93c, 94, 95), making it possible to maintain the liquid medium at a pH of less than 4.

31. Device according to Claim 30, characterized in that the nitrate reduction enclosure (56) is arranged vertically and it comprises at least one zinc layer (70, 85a, 85b, 85c, 99a, 99b, 99c, 99d, 99e, 99f, 99g), which is transversely arranged over the entire width of the enclosure (56) and which is produced by the compression of zinc chips between two perforated plates (71, 72, 86a, 86a', 86b, 86b', 86c, 86c'), in that the liquid inlet (57) is

arranged in the lower part of the enclosure (56), in that the liquid outlet (58) is arranged in the upper part of the enclosure (56), and in that the device comprises, in addition, a recirculation pump (59) making it possible to ensure the circulation and the recirculation of the liquid from the inlet (57) to the outlet (58) by traversing all the zinc layers (70, 85a, 85b, 85c, 99a, 99b, 99c, 99d, 99e, 99f, 99g).

32. Device according to one of Claims 29-31, characterized in that the height of each zinc layer (70, 85a, 85b, 85c, 99a, 99b, 99c, 99d, 99e, 99f, 99g) is less than 10 cm.

33. Device according to any one of Claims 29-32, characterized in that the enclosure (56) comprises a system for stirring the liquid, (75) making it possible to stir the liquid circulating in the enclosure (56) above each zinc layer (70, 85a, 85b, 85c, 99a, 99b, 99c, 99d, 99e, 99f, 99g) by forming a corresponding stirring zone (78, 92a, 92b, 92c, 99a1, 99b1, 99c1, 99d1, 99e1, 99f1, 99g1).

34. Device according to Claim 33, characterized in that the stirring speed of the liquid in each stirring zone (78, 92a, 92b, 92c, 99a1, 99b1, 99c1, 99d1, 99e1, 99f1, 99g1) is approximately 0.85 m/s.

35. Device according to any one of Claims 33 or 34, characterized in that at least one stirring zone out of two is connected to the pH regulator.

36. Device according to Claim 35, characterized in that the pH regulator can comprise at least one probe (93a, 93b, 93c) that measures the pH in the corresponding stirring zone (78, 92a, 92b, 92c, 99a1, 99b1, 99c1, 99d1, 99e1, 99f1, 99g1), a control enclosure (94) and an acid circulation pump (95).

37. Device according to Claim 36, characterized in that the pH regulator maintains the pH in the corresponding stirring zone between 2 and 3.

38. Device according to any one of Claims 29-37, characterized in that the circulation speed of the liquid in the enclosure (56) is approximately 0.01 m/s.

39. Device according to any one of Claims 31-38, characterized in that the enclosure (56) comprises at least three zinc layers (70, 85a, 85b, 85c, 99a, 99b, 99c, 99d, 99e, 99f, 99g).

40. Device according to any one of Claims 29-39, characterized in that it comprises, in addition, a zinc reduction enclosure (106), in which the liquid (68) circulates at the outlet of the nitrate reduction enclosure (56).

41. Device according to Claim 40, characterized in that the zinc reduction enclosure (106) comprises at least one electrolysis cell (110a, 110b, 110c, 110d, 110e, 110f).

42. Device according to Claim 41, characterized in that each cathodic electrode (108a, 108b, 108c) of the respective electrolysis cells (110a, 110b, 110c, 110d, 110e, 110f) is produced by the compression of carbon particles between two perforated plates (116b, 116b') and in that at least one electrode forming means (117) is inserted into the carbon grains and connected to the negative pole of a current generator.

43. Device according to any one of Claims 41 or 42, characterized in that each anodic electrode (109a, 109b, 109c, 109d) of the respective electrolysis cells (110a, 110b, 110c, 110d, 110e, 110f) is produced by the compression of zinc chips between two perforated plates (118a, 118a'; 118b, 118b') and in that at least one electrode forming means (119b, 119c) is inserted into the zinc chips and connected to the positive pole of a current generator.

44. Device according to any one of Claims 41-43, characterized in that the zinc reduction enclosure (106) comprises at least three electrolysis cells (110a, 110b, 110c, 110d, 110e, 110f).

45. Device according to any one of Claims 42-44, characterized in that the zinc reduction enclosure (106) is vertical and the anodic electrodes (109a, 109b, 109c, 109d) and the cathodic electrodes (108a, 108b, 108c), which form the corresponding electrolysis cells (110a, 110b, 110c, 110d, 110e, 110f), are arranged transversely over the entire width of the enclosure (106), so that all the liquid circulating in the enclosure (106) traverses the electrolysis cells, in that the liquid inlet (111, 115) is arranged in the lower part of the of the enclosure (106), in that the liquid outlet (112) is arranged in upper part of the enclosure (106), and in that the device of the invention comprises, in addition, a recirculation pump (113) making it possible to ensure the circulation and recirculation of the liquid from the inlet (111, 115) up to the outlet (112) by traversing all the electrolysis cells (110a, 110b, 110c, 110d, 110e, 110f).

46. Device according to any one of Claims 40-45, characterized in that it comprises a pH regulator that maintains the pH of the liquid medium circulating in the zinc reduction enclosure (106) at a pH above 7.

47. Use of the method according to any one of Claims 1-28 and of the device according to any one of Claims 29-46 for treating any liquid medium loaded with nitrates.

48. Use according to Claim 47, in which the liquid medium consists of drainage waters from cultivation.